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October 6, 2011

Mr. Garry A. Rhodes, *Building Commissioner*
Office of Community Development
Town of Lexington
1625 Massachusetts Avenue
Lexington, MA 02420

Subject: Sunday Morning Sound Levels
Lexington Technology Park

Dear Garry,

During our meeting of Monday, October 3, 2011, it was noted that sound levels produced by Shire HGT equipment on Sunday mornings has been observed by neighbors to be an annoyance. They and others of the Town have asked if it is possible to evaluate compliance of Shire sound levels with the Lexington Noise By-Law by measuring sound during one or more typical Sunday mornings at compliance locations and at residential property.

In principal it is possible to evaluate compliance of Shire sound levels at receptor locations during typical Sunday mornings. This would first require determining background sound levels during a typical Sunday morning by repeating the procedures employed in May 2010 to determine the background sound level during early morning hours. Once the typical Sunday morning background sound level has been determined, sound levels would be re-measured with Shire operating at summer daytime operating conditions, or some other representative high level operating condition. If Shire equipment sound levels at receptor locations do not exceed the Sunday morning background sound level by more than 10 dBA, Shire operations would be in compliance with the Lexington Noise By-Law.

It was also asked if there is some way to evaluate Shire compliance with the Noise By-Law on Sunday mornings without using the involved procedures of May 2010 to establish the Sunday morning background. This is possible, if a key assumption is made. If it is assumed that background sound levels at 2:00 AM in May 2010 were produced predominantly by traffic on Routes 2 and 128, then the 2:00 AM background sound level can be adjusted by a factor accounting for the differences in traffic volumes. Under this assumption, the Sunday morning background sound level is equal to the 2:00 AM background sound level plus $10 \log(p)$, where "p" is the ratio between Sunday morning and 2:00 AM traffic volumes on Routes 2 and 128. This is only valid if the ratio for Routes 2 and 128 individually are about the same.

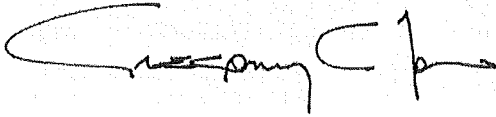
The preceding adjustment is reliable to an extent, but does not account for differences in atmospheric propagation between still early morning hours and mid to late mornings. These propagation differences can act to increase or decrease estimated Sunday morning background sound levels from those estimated using the preceding method. This needs to be kept in mind when estimating Sunday morning background sound levels using traffic data and nighttime background sound levels.

Mr. Garry A. Rhodes, Town of Lexington
October 6, 2011

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If we can provide any further information, please do not hesitate to contact us. Thank you.

Yours sincerely,
CAVANAUGH TOCCI ASSOCIATES, INC.

A handwritten signature in black ink, appearing to read "Gregory C. Tocci", with a stylized flourish at the end.

Gregory C. Tocci, *President*

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Sunday Mornings 2011.10.06.Doc

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September 16, 2011

Mr. Garry A. Rhodes, *Building Commissioner*
Office of Community Development
Town of Lexington
1625 Massachusetts Avenue
Lexington, MA 02420

Subject: Review of Sound Level Compliance Report
Lexington Technology Park

Dear Garry,

Acentech report dated September 9, 2011 evaluates compliance of Shire HGT building equipment sound with the Town of Lexington Noise By-Law (Section 80). The report concludes that sound produced Shire HGT building equipment during a typical warm summer night would conform to the Town of Lexington By-Law on noise. The following briefly summarizes their analysis and includes our comments.

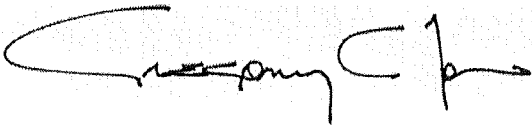
1. The Lexington Noise By-Law, and its citing of MassDEP policy 90-001, contains the limits for appropriately evaluating Shire HGT compliance.
2. The instrumentation used and its method of use are appropriate and were generally the same as those used to determine background sound levels in May 2010.
3. Compliance measurement locations and elevations above the ground are the same as those used for evaluating background sound in the May 2010 measurements as indicated in the Acentech June 16, 2010 report.
4. Shire HGT and Acentech appeared to have made a diligent effort to replicate warm summer night building equipment operating conditions. However, the Building 300 cooling tower appeared to them to have not reached the higher operating speed expected. Accordingly, computer modeling was employed to upwardly adjust measured sound levels leading to a possible overestimate of facility sound at compliance locations.
5. The existing background sound levels used for evaluating the increase in sound levels produced by Shire equipment operating in a "warm summer night" mode were those reported in Table 4 of the June 16, 2010 Acentech report.
6. Sound levels were measured in one-minute intervals during the equipment "warm summer night" operating condition. Reported sound levels at each location are the average of the highest 30 minute samples measured over the 45-minute equipment operating time period. As noted above, measured sound levels were adjusted to account for less than full capacity operation of Building 300 cooling towers.

7. Table 4 of the Compliance report indicates Shire equipment sound levels at compliance locations A through E are within 10 dBA of the background sound levels in the June 2010 report, thus demonstrating compliance with the 10-dBA above background limit of the Lexington Noise By-Law.
8. Sound level data was not measured at compliance location F. This location is situated between locations B and E. It is reasonable to expect that facility sound level at location F would fall between 47 and 50 dBA, the facility sound levels measured at E and B respectively, and would not be higher than 50 dBA. The background sound level determined at location F was 42 dBA, suggesting that Shire equipment sound at location F would also comply with the Lexington Noise By-Law.
9. A tonal sound condition was measured at location A in the 1000 Hz octave band, and at location D in the 63 Hz octave band. Acentech indicated that the tone at location A was produced by Shire equipment and that steps were underway to correct this condition. They also indicated that the tone at location D was produced by truck traffic on Route 128. Though this was not confirmed by measurements of sound close to Shire equipment, it is a reasonable conclusion, and in my opinion does not require further verification.

In summary, we concur with the Acentech conclusion that Shire HGT equipment sound, when operating at or near full-capacity as would be typical of a warm summer night, conforms to the 10-dBA limit above background of the Lexington Noise By-Law, and pending implementation of controls by Shire to mitigate a minor tonal condition at location A, will comply with the By-Law tonal restriction as well.

If we can provide any further information, please do not hesitate to contact us. Thank you.

Yours sincerely,
CAVANAUGH TOCCI ASSOCIATES, INC.



Gregory C. Tocci

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TOWN OF LEXINGTON



MASSACHUSETTS 02420

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Building Department X-211
Conservation Commission X-226

Board of Health X-200
Zoning Board of Appeals X-207
Historic Districts Commission X-216

Jim Winiarski, Senior Director
Real Estate Planning and Project Management
Shire Human Genetic Therapies, Inc.
700 Main Street
Cambridge, MA 02139

September 16, 2011

Re; Shire HGT Compliance Sound Monitoring Protocol

Dear, Mr. Winiarski,

As you move forward with future testing of sound levels please use the following protocol.

Instrumentation to be used and its methods of use: The Instruments used shall be generally the same as noted in the Ambient Sound Level Assessment Protocols March 11, 2010 and used in both the June 16, 2010 ambient sound level assessment and during August 4, 2011 testing.

Compliance measurement locations and elevations: Compliance locations shall be generally the same as those referenced in the Ambient Sound Level Assessment Protocols March 11, 2010. The height of the test shall be at an elevation equal (as close as possible) to the lines-of-sight between the rooftop equipment and the residences located on Shade Street. In the alternative, the testing may be done at the residences such as an upper deck.

Compliance measurement times: Measure sound levels between 2 and 4 AM on a weekday to evaluate nighttime compliance. In addition, measure sound levels at the same locations on Sunday morning 8 to 10 AM.

Facility operating conditions: It is the purpose of compliance measurements to determine sound levels at compliance locations during "worst operating conditions," meaning measurements under equipment operation characteristics when Shire equipment sound levels are the highest. As noted above, there are two time windows that should be tested: nighttime (weekday, 2 to 4 AM) and daytime (Sunday, 8 to 10 AM).

It is assumed that the facility management can and would force systems simultaneously into noisiest operation conditions for periods long enough to permit compliance sound measurement. Shire shall make every attempt to operate the facility in a manner replicating noisiest likely conditions for both time windows and they should record equipment operating characteristics during testing and include a record of operating characteristics in your compliance test report. It is necessary that all Shire equipment for all buildings be operated simultaneously at noisiest operating conditions during all compliance measurements.

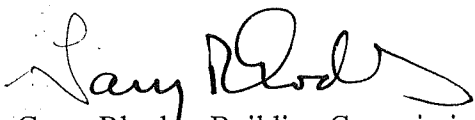
Descriptor: You shall use 90th percentile A-weighted sound level . Shire HGT sound at receptor locations is the compliance measurement sound level minus the background sound level determined at compliance locations during May 2010 studies.

Compliance measurement time interval: If it is not possible to permit equipment to operate continuously for a long period of time, it is suggested that the time interval for compliance measurements may need to be short. Shire, together with its acoustical consultant would need to consider this in setting measurement time intervals.

Time histories: Provide, if possible, extending from normal Shire equipment operation just prior to compliance measurements, through operation of equipment at noisiest operating conditions for testing purposes and back to a period of normal Shire equipment operation. Annotations would need to identify sources of transient sound occurring and showing how the nearly constant sound produced by Shire equipment must set a noise floor for environmental sound.

If you would like to meet to discuss these testing protocols please let me know.

Sincerely,

A handwritten signature in black ink, appearing to read "Garry Rhodes", with a stylized, flowing script.

Garry Rhodes, Building Commissioner

Cc. Carl Valente, Town Manager

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NICHOLAS BROWSE, SMPTE
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August 11, 2011

Mr. Garry A. Rhodes, *Building Commissioner*
Office of Community Development
Town of Lexington
1625 Massachusetts Avenue
Lexington, MA 02420

Subject: Shire HGT Compliance Sound Monitoring Protocol

Dear Garry,

During our meeting with the community on the evening of August 9, 2011, we discussed the means by which Shire HGT would evaluate its compliance with the Chapter 80 Lexington Noise Ordinance. As you noted in the meeting, it was previously assumed that compliance measurements would be conducted using the same protocol used to determine background sound levels in May 2010. On further discussion at the meeting, several refinements to the original protocol were suggested that Shire's consultant, Acentech should consider incorporating into their compliance measurement protocol. The following discusses these refinements.

When to Measure.

Measure sound levels between 2 and 4 AM on a weekday to evaluate nighttime compliance. In addition, measure sound levels at the same locations during Sunday morning, 8 to 10 AM. This latter measurement responds to neighborhood complaints of Shire equipment sound during residents' outdoor activities, particularly during otherwise quietest daytime periods.

Facility Operating Conditions

It is the purpose of compliance measurements to determine sound levels at compliance locations during "worst operating conditions," meaning measurements under equipment operating characteristics when Shire equipment sound levels are the highest. As noted above, there are two time windows that should be considered: nighttime (weekday, 2 to 4 AM) and daytime (Sunday, 8 to 10 AM).

It is assumed that the facility management can and would force systems simultaneously into noisiest operating conditions for periods long enough to permit compliance sound measurements. The protocol should include a description of equipment operating characteristics corresponding to "noisiest operating condition." It is understood, that such a condition might not correspond to a unique arrangement of equipment operating characteristics. Nevertheless, Shire would need to make every attempt to operate the facility in a manner replicating noisiest likely conditions for both time windows, and that they should record equipment operating characteristics during testing and include a record of operating characteristics in their compliance test report.

It is necessary that all Shire equipment for all buildings be operated simultaneously at noisiest operating conditions during all compliance measurements.

Descriptor: L_{90} or L_{eq} ?

We recommend that the 90th percentile A-weighted sound level be measured. Shire HGT sound at receptor locations is the compliance measurement sound level minus the background sound level determined at compliance locations during May 2010 studies.

During the meeting, I recommended that Shire should measure the L_{eq} for compliance measurements. On further consideration, I recommend that the L_{90} be used instead, as the L_{eq} may be more influenced by traffic noise than would the L_{90} .

Compliance Measurement Time Interval

As it may not be possible to permit equipment to operate continuously for a long period of time, it is suggested that the time interval for compliance measurements may need to be short, perhaps as short as 5-minutes to avoid equipment from shutting down to prevent damage. Shire, together with its acoustical consultant, would need to consider this in setting measurement time intervals.

Additional Compliance Locations

Several Shade Street neighbors have asked that compliance of Shire equipment sound levels be evaluated at their residences, including upper story locations. Accordingly, we recommend that sound levels be measured at compliance locations at the approximate 5-foot elevation originally used in sound measurements, and at elevations approximately intercepting lines-of-sight between Shire rooftop equipment and first and upper story receptor locations.

At neighbor requests, it would be acceptable to also measure at first floor and upper stories of residences. I would caution, though, that compliance measurements should not be made in enclosed spaces or semi-enclosed spaces of Shade Street residences, particularly inside screened-in porches, where sound reflections within such confined spaces can elevate sound levels from those measured outside where compliance is required.

Time Histories

The neighbors indicated that they would like to see a time history of A-weighted sound level during compliance sound measurements. I mentioned that interpreting such data can be difficult as there is no way of separating Shire equipment sound from that produced by non-Shire sources in these time histories. However, it might be instructional for the neighbors to see a well annotated time history extending from normal Shire equipment operation just prior to compliance measurements, through operation of equipment at noisiest operating conditions for testing purposes, and back to a period of normal Shire equipment operation. Annotations would need to identify sources of transient sound occurring and showing how the nearly constant sound produced by Shire equipment might set a noise floor for environmental sound.

Summary

The following is a brief summary of features that should be considered by Acentech for incorporation into their compliance measurement protocol for Shire HGT equipment and facilities:

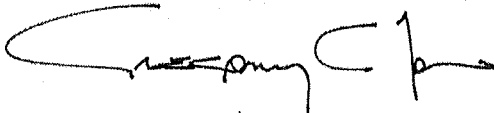
- ☐ Measure sound levels between 2 and 4 AM as was done during May 2010 measurements. In addition, measure sound levels between 8 and 10 AM on a Sunday morning.
- ☐ Measure sound levels during facility "worst operating conditions," presumably meaning during nighttime and daytime "noisiest operating conditions."
- ☐ Use the 90th A-weighted sound level for compliance sound level measurements.
- ☐ If necessary to avoid equipment shut-downs to protect equipment, conduct compliance measurements during short time-intervals to ensure that all equipment is operating at design conditions.
- ☐ Measure sound levels at compliance locations at the approximate 5-foot elevation originally used in sound measurements, and at elevations approximately intercepting lines-of-sight between Shire rooftop equipment and first and upper story receptor locations.
- ☐ Provide annotated time histories of A-weighted sound levels over periods prior to, during, and for a period of time after compliance testing.

It must be noted that these recommendations should be adopted by Acentech as they see fit, as they address concerns of the Town, and as they would provide for a more comprehensive compliance test. The compliance measurement protocol should be submitted to the Town prior to measurements for its consideration.

* * *

If we can provide any further information, please do not hesitate to contact us. Thank you.

Yours sincerely,
CAVANAUGH TOCCI ASSOCIATES, INC.



Gregory C. Tocci

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